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# Ship Investment at a Standstill?

# An Analysis of Shipbuilding Activities and Policies

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## Abstract

In the wake of the global financial crisis which started around mid-2008, the global shipbuilding industry is no longer in a state of euphoria as before. The volume of new ship orders dropped dramatically after August 2008. We are motivated to examine three issues in this paper: First, in the context of shipping industry, which variable/variables play the most important role in a ship investment decision? Second, do government support and favourable investment conditions really help to save shipbuilding industry from the distressing situation? Third, if we separate Japan, South Korea and China as leading shipbuilding clusters, what will the cluster effect be? Our results indicate: The investment of ships can be decided by the freight level, the supply of the market (fleet size), the demand of the ships (trade volume) and the transportation service share (location advantage). However, the state of the freight market is of major importance to the investment decision of ships. Shipbuilding price, secondhand ship price and foreign

direct investment in transportation are proved to have no linkage to ship investment. Besides, the rising role of Japan, South Korea and China in shipbuilding is also identified.

**Keywords**: Maritime transport; shipbuilding market; Shipping policy; Panel data

## 1. Introduction

Ever since the financial crisis started around mid-2008, the global shipbuilding industry has not been in a state of euphoria any more. As shown in Figure 1, the contract volume of booked new ships plummeted dramatically after August 2008, and not a single contract was received by worldwide ship builders for a whole month of May 2009. Ship investors want to either cancel the shipbuilding orders or put off the ship delivery dates. Ship manufacturers in the whole world are in a distressing situation. We are hereby motivated to examine three issues to better understand the economics of the shipbuilding market. First, what are the main determinants of the amount of shipbuilding order contracts? Research on shipbuilding market has attracted the attention in the fields of maritime policy and international business. It is necessary to explain and determine how investors decide to invest new ships. Second, shipbuilding industry has been known as an industry enjoying enormous government support and favourable investment conditions. Will these favourable conditions really help to save shipbuilding industry from the distress? Third, Japan, South Korea and China have been known as three leading shipbuilding countries, our paper tests the cluster effect in shipbuilding industry.

Shipbuilding is a very attractive industry for a country as it can bring in substantial amount of foreign investment. However, most studies on shipbuilding are from the technological perspective, such as ship design and shipbuilding innovation. There are relatively fewer economic analyses on shipbuilding market. The limited ones have mostly focused on the shipbuilding prices, few of them analysed how and why the amount of shipbuilding orders fluctuates over time. Unlike previous shipbuilding market studies in the literature, our paper extends previous studies from the shipbuilding price to shipbuilding orders, in which the variable may better indicate the shipbuilding activities.

The determinants of investment can be discussed from micro-economic and macro-economic perspectives. At the firm level, the following two factors are considered by most studies: expected benefits and funds, i.e. changes in sales and profits and the level of capital stock, both in terms of availability and cost. The common variables they considered as the determinants of investment behaviours are: Capital stock (Eisner, 1964; Jorgenson and Stephenson, 1965), capacity utilization (Anderson, 1967; Meyer and Glauber, 1964), profits (Anderson, 1967; Eisner, 1964; Meyer and Glauber, 1964) and interest rate (Anderson, 1967; Meyer and Glauber, 1964). At the industrial level, Boatwright and Eaton (1972) studied the investment in plant and machinery in manufacturing industry in the United Kingdom. Apart from the common elements considered at the firm level, their study emphasized the impact of governmental incentive schemes on certain industries to stimulate investment.

In regard to the determinants of ship investment, Marlow (1991) wrote a trilogy about investment incentives and shipping industry, and his third paper specifically discussed the major determinants of investment in the UK shipping industry. Apart from the common determinants of investment behaviour, expectation was also included as one of the variables. In shipping context, expectations include, for example, the state of the market, freight rates, changing costs, new technology, and flag of registry. Besides, Engelen, Meersman and Voorde (2006) claimed that the ordering behaviour is claimed to depend on the level of rates, since the earning potential of a ship (freight rate) over its lifetime is considered as the price of the ship. Bessler, Drobetz and Seidel (2008) suggested that time series properties of freight rates need to be well understood before investing in ship funds.

While previous studies are more about ship investment behaviour of individual countries (Marlow, 1991; Kind and Strandenes, 2002), our estimations will be carried out using panel data analysis. The panel data aggregates all the individuals; this method allows us to model differences in behaviour across individuals over time. The remainder of this paper is organized as follows: 2 Data Description and Hypothesis Development, 3 Econometric Methodology and Model Development, and finally 4 Conclusions.

## 2. DATA DESCRIPTION AND HYPOTHESIS DEVELOPMENT

### Data

In this study, the data set contains information of 15 major shipbuilding countries. The contracts received by these 15 countries account for 94.78% of the contracts received worldwide in 2008 (see Table 1). Our data set is annually based and covers the period from 1996 to 2008. The data sources we use in this study are from Clarkson's Shipping Intelligence Network, OECD statistics and World Development Indicators from the World Bank Group.

The basic models 2 and 3 consist of the following 11 variables as reported in Table 2: the volume of ordered new ships in each period (CONTRACT), representing the ship investment situation; total world fleet size (FS) and total world orderbook (ORDERBOOK), implying the supply of shipping service; international trade volume of exports in goods (TRADE), implying the demand for shipping service; ClarkSea Freight Index (FREIGHT), indicating the freight level of shipping market; and gross domestic product per capita (GDPPC), serving as the control variable. We further add newbuilding ship price (NBP), secondhand ship price (SHP), foreign direct investment in transportation (FDI), share of transport service in total export services (TS) to the basic model. Finally, dummy variables (CLUSTER) are included to reflect the cluster effect of the three major shipbuilding countries (Japan, South Korea and China). The measurements and sources of the variables are listed in Table 2. Hypotheses designed to test these variables will be explained later.

**Hypothesis Development**

Based on various research papers on investment behaviour, 8 hypotheses, covering capital stock, potential earning, investment incentives and location advantage, are designed to capture the major determinants of ship investment. We present the hypotheses as below, explanations will be made together with model development in the next session.

*Capital stock hypothesis*

> *Hypothesis 1 Variables representing capital stock, such as fleet size and existing orderbook are negatively related to ship investment.*

*Potential earning hypotheses*

> *Hypothesis 2 International trade volume of exports is positively related to ship investment.*
>
> *Hypothesis 3 Freight rate, representing the expectation of the state of the market, is positively related to ship investment.*
>
> *Hypothesis 4 Newbuilding ship price, representing the expectation of the changing costs in investing new ships, is negatively related to ship investment.*
>
> *Hypothesis 5 Secondhand ship price, representing expectation-changing costs in investing secondhand ships, is positively related to ship investment.*

*Investment incentives hypothesis*

> *Hypothesis 6 FDI in transportation is positively related to ship investment.*

*Location advantage hypotheses*

> *Hypothesis 7 Share of transport service in total export services is positively related to ship investment.*
>
> *Hypothesis 8 Interactions between shipbuilding clusters and fleet size, trade volume and freight rate significantly contribute to the increase of ship investment.*

## 3. ECONOMETRIC METHODOLOGY AND MODEL DEVELOPMENT

The data is collected from 15 major shipbuilding countries over the period from 1996 to 2008. The impact of each of the factors discussed in this study varies from shipowner to shipowner and from country to country, therefore, the fundamental advantage of using panel data set over a cross section is that it allows great flexibility in modelling differences in behaviour across individuals over time (William, 2008). The basic framework for this discussion is a regression model of equation (1):

$$y_{it} = x'_{it}\beta + z'_i\alpha + \varepsilon_{it} \quad (1)$$

where $x_{it}$ represents the regressors, $z'_i\alpha$ represents the heterogeneity, or individual effect, where $z_i$ contains a constant term and a set of individual or group specific variable.

We develop 9 models to test our hypotheses and report them in Table 3. All the 9 models are with a considerably high adjusted R squared value of around 0.7. The F statistics also show that the independent variables (except the variables NBP, SHP and FDI in the models 4, 5 and 6) as a group explain a statistically significant share of variation in the dependent variable.

Hypotheses 1 to 3 are tested throughout the 9 models. The following model 2 and model 3 are basic models containing variables in hypotheses 1 to 3. Hypothesis 1, concerning capital stock (fleet size and orderbook), is confirmed by 7 out of 9 models. We have separately tested ORDERBOOK in model 3, and chose FS to represent capital stock in the other 8 models. As can be observed in Table 3, both FS and ORDERBOOK are negatively related to ship investment. This finding is in line with our theoretical

consideration, since the higher the existing capital stock is, the lower the investment net of replacement will be. Hypothesis 2 is confirmed by 8 out of 9 models: international trade volume of exports and ship investment are positively related, given that higher level of demand in ships requires more investment in the market. Hypothesis 3 is also accepted by 8 out of 9 models, a higher freight rate indicates a prosperous shipping market, which makes shipowners expect a high return in freight market, thus willing to invest new ships. Among the three basic variables (FS, TRADE and FREIGHT), FREIGHT has an obviously higher significance level than the other two, this observation tells us that shipowners will be willing to invest new ships most when they confide in a profitable freight market. The supply of the market (fleet size) and the demand of the ships (trade volume) are also among their considerations, but not as important as the freight level factor.

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 FS_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 GDPPC_t + \varepsilon_t \quad (2)$$

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 ORDERBOOK_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 GDPPC_t + \varepsilon_t \quad (3)$$

Model 4 is designed to test hypothesis 4. Since a higher newbuilding ship price means higher costs in building new ships, we expect a negative relationship between newbuilding ship price and ship investment. However, hypothesis 4 is not confirmed according to model 4's result, the variable NBP is not statistically significant as reported in Table 3. Newbuilding ship price is thus proved to be irrelevant to ship investment.

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 FS_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 NBP_t + \beta_6 GDPPC_t + \varepsilon_t \quad (4)$$

Hypothesis 5, tested by model 5, cannot be proved either. The variable SHP is not statistically significant to ship investment. The rejection of hypotheses 4 and 5 suggests that changing costs on building new ships does not affect shipowners' decision of investing new ships. One possible reason for this is that the changing costs only take a small proportion of the total investment of building new ships, hence the shipowners care much more on the total sunk cost and the future payoff of the ships.

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 FS_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 SHP_t + \beta_6 GDPPC_t + \varepsilon_t \quad (5)$$

The hypothesis relating to the effect of FDI on ship investment, hypothesis 6, is tested through model 6. The result of model 6, reported in Table 3, failed to show a positive relationship between FDI volume and ship investment. The reasons are twofold, first, the FDI volume depends a lot on the favourable fiscal policy and investment incentives of the host country, however, it has been proved by many studies of no real relationship between investment incentives and the level of shipping investment (Boatwright and Eaton, 1972; Marlow, 1991); Second, It has been found that service providers in transport or repair and maintenance markets attracts more FDI than industrial manufacturers (Kind and Strandenes, 2002), therefore, the higher FDI volume in the host country does not necessarily equal more investment on new ships.

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 FS_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 FDI_t + \beta_6 GDPPC_t + \varepsilon_t \quad (6)$$

Hypothesis 7 is confirmed by the results of models 7 to 10 in Table 3, that is, the variable TS is positive and highly significant to the variable CONTRACT. A large share of transport service in total export services shows the presence of long-standing customers' market of shipping service, which shows the country's cluster effect. This result is therefore supported by many studies discussing about the enormous cluster advantage to the shipping investment (Akselsen, 2000, Tenold, 2000; and Kind and Strandenes, 2002).

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 FS_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 TS_t + \beta_6 GDPPC_t + \varepsilon_t \quad (7)$$

Models 8 to 10 further test hypothesis 8, relating to the interactions between shipbuilding clusters and fleet size, trade volume and freight rate, respectively. Japan, China and South Korea have been known as the major maritime clusters. The results in Table 3 show that the interactions variables significantly contribute to the increase of ship investment, which can be interpreted as: with the same levels fleet size, trade volume and freight rate, the shipbuilding clusters, namely Japan, South Korea and China, still attract more contracts of shipbuilding. This finding is in accordance with the real situation: shipbuilding industry has been identified as a key and strategic industry in these three countries in recent years. This result shows the great importance of the cluster effect to ship investment.

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 FS_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 TS_t + \beta_6 CLUSTER * FS + \beta_7 GDPPC_t + \varepsilon_t \quad (8)$$

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 FS_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 TS_t + \beta_6 CLUSTER * TRADE + \beta_7 GDPPC_t + \varepsilon_t \quad (9)$$

$$CONTRACT_t = \beta_0 + \beta_1 CONTRACT_{t-1} + \beta_2 FS_t + \beta_3 TRADE_t + \beta_4 FREIGHT_t + \beta_5 TS_t + \beta_6 CLUSTER * FREIGHT + \beta_7 GDPPC_t + \varepsilon_t \quad (10)$$

## 4. Conclusions

In summary, our estimations through pooled panel data analysis show that the three basic variables, i.e. world fleet size, world trade volume, and spot freight rate, are important to the amount of shipbuilding orders. This finding implies how important the shipowners' confidence in freight market is when they decide whether to invest new ships. Shipbuilding price and secondhand ship price, reflecting the changing costs of shipbuilding, were proved to have no linkage to the amount of shipbuilding orders. Moreover, the FDI volume in transportation in the host country does not necessarily lead to more investment on new ships. With regard to location factor and cluster effect, we found that location advantage and cluster effect are of great help to attracting more shipbuilding orders.

Comparing the significance level of freight level factor and other determinants of the amount of shipbuilding orders, it was felt that only if the freight market became prosperous again, we would by then expect a prosperous shipbuilding market. It has also been observed the strong cluster effect of Asian countries in the shipbuilding sector, namely Japan, South Korea and China. With the same levels of fleet size, trade volume and freight rate, shipowners will still go to these leading shipbuilding nations to build new ships. This shows a great cluster advantage of these three countries for being a large consumers' market for maritime transportation.

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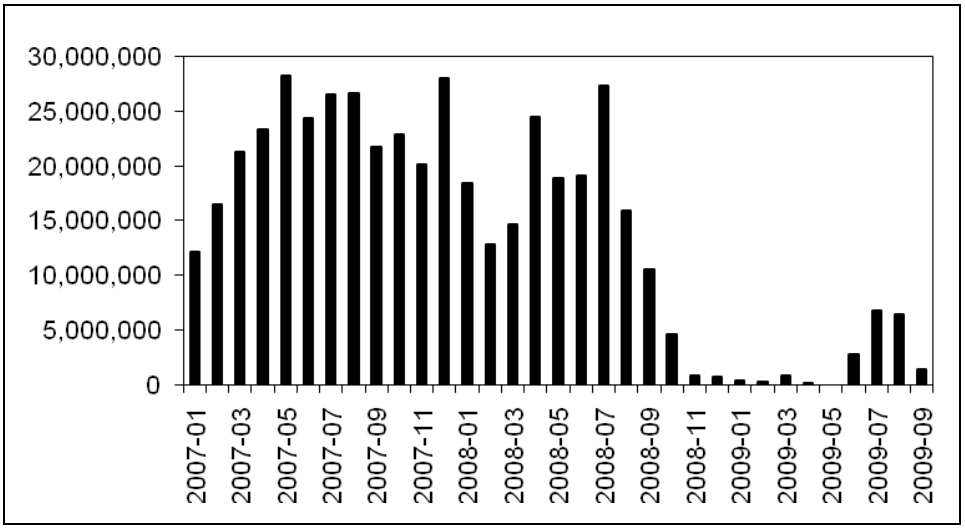
Figure 1 Contracts in deadweight tonnage received by ship builders worldwide




Source: Clarkson's Shipping Intelligence Network

Figure 2 Distribution of contracts in deadweight tonnage

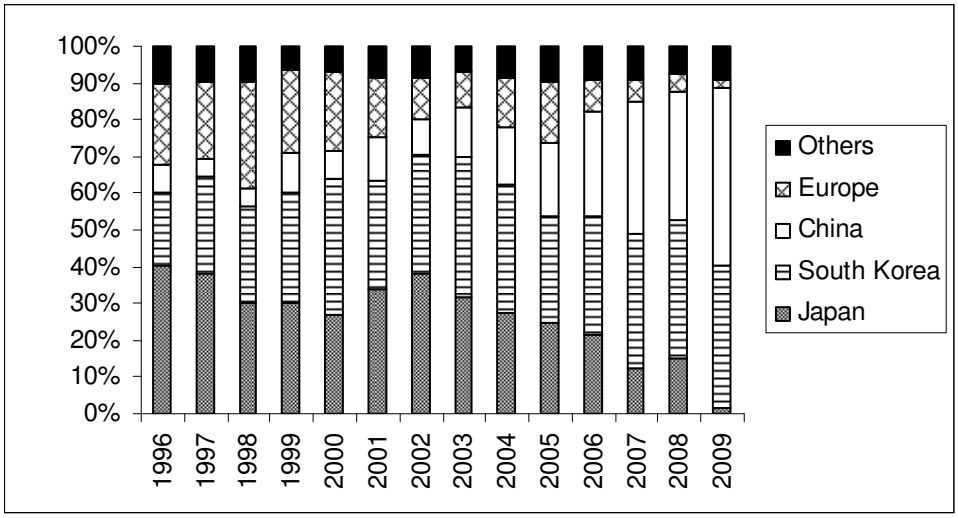


Table 1 Contracts by country of build (2008)

| ***Country*** | ***Deadweight Tonnage*** | ***Percentage*** |
|---|---|---|
| Brazil | 241,362 | 0.14% |
| Denmark | 23,000 | 0.01% |
| Finland | 10,000 | 0.01% |
| France | 600 | 0.00% |
| Germany | 468,550 | 0.28% |
| Italy | 65,000 | 0.04% |
| Japan | 25,976,539 | 15.46% |
| Netherlands | 231,470 | 0.14% |
| Norway | 56,300 | 0.03% |
| P.R. China | 61,748,392 | 36.74% |
| Poland | 82,100 | 0.05% |
| South Korea | 69,411,961 | 41.30% |
| Spain | 144,200 | 0.09% |
| Turkey | 771,600 | 0.46% |
| USA | 56,670 | 0.03% |
| Total | | 94.78% |

Source: Clarkson's Shipping Intelligence Network

Table 2 List of variables

| ***Variable*** | ***Source*** | ***Description*** |
|---|---|---|
| CONTRACT | SIN data | Contract: Contracts By Area/Country of Build (DWT) |
| FS | SIN data | Fleet Size: Total world fleet in million (DWT) |
| ORDERBOOK | SIN data | Orderbook: Total world Orderbook in million (DWT) |
| TRADE | OECD statistics | Trade: International trade of exports in goods (billions of US dollars) |
| FREIGHT | SIN data | Freight: ClarkSea Index |
| GDPPC | World Bank | Gross Domestic Product Per Capita |
| FDI | OECD statistics | Foreign Direct Investment: FDI inward flows in transports (Millions of US dollars) |
| TS | World Bank | Transportation Service: Share of transportation service in total export services (%) |
| SBP | SIN data | Shipbuilding price: Shipbuilding Price Index |
| SHP | SIN data | Secondhand ship price: Total Sales Volume (DWT) |
| CLUSTER | | Cluster Effect (Japan, South Korea and China) |

Note: SIN denotes "Clarkson's Shipping Intelligence Network".
DWT denotes Deadweight Tonnes

Table 3 Pooled OLS estimations of the amount of shipbuilding order contracts models

| | *Dependent variable: CONTRACT$_t$* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Explanatory variable* | Eq. (2) | Eq. (3) | Eq. (4) | Eq. (5) | Eq. (6) | Eq. (7) | Eq. (8) | Eq. (9) | Eq. (10) |
| CONTRACT$_{t-1}$ | 0.793** | 0.799** | 0.791** | 0.799** | 0.866** | 0.662** | 0.449** | 0.461** | 0.450** |
| | (15.720) | (15.946) | (15.609) | (15.742) | (14.218) | (10.910) | (6.216) | (6.449) | (6.206) |
| FS | -3.903* | | -4.670* | -4.798* | -6.214** | -3.441* | -2.659 | -2.935* | -2.607 |
| | (-2.089) | | (-2.146) | (-2.340) | (-2.926) | (-1.904) | (-1.565) | (-1.726) | (-1.530) |
| ORDERBOOK | | -1.140** | | | | | | | |
| | | (-2.706) | | | | | | | |
| TRADE | 0.211* | 0.212* | 0.212* | 0.203* | 0.210 | 0.458** | 0.309* | 0.293* | 0.309* |
| | (1.750) | (1.781) | (1.758) | (1.681) | (1.335) | (3.376) | (2.364) | (2.215) | (2.360) |
| FREIGHT | 1.259** | 1.633** | 1.023* | 0.809 | 1.527** | 1.158** | 1.108** | 1.084** | 1.068** |
| | (2.894) | (3.385) | (1.848) | (1.330) | (3.106) | (3.675) | (2.809) | (2.735) | (2.697) |
| SBP | | | 0.925 | | | | | | |
| | | | (0.691) | | | | | | |
| SHP | | | | 0.716 | | | | | |
| | | | | (1.058) | | | | | |
| FDI | | | | | -0.003 | | | | |
| | | | | | (-0.037) | | | | |
| TS | | | | | | 1.158** | 0.850** | 0.875** | 0.845** |
| | | | | | | (3.675) | (2.816) | (2.896) | (2.789) |
| CLUSTER x FS | | | | | | | 0.301** | | |
| | | | | | | | (4.795) | | |
| CLUSTER x TRADE | | | | | | | | 0.579** | |
| | | | | | | | | (4.672) | |
| CLUSTER x FREIGHT | | | | | | | | | 0.207** |
| | | | | | | | | | (4.727) |
| GDPPC | -0.215* | -0.208* | -0.218* | -0.211* | -0.257 | -0.516** | -0.251* | -0.265* | -0.251* |
| | (-1.986) | (-1.943) | (-2.014) | (-1.954) | (-1.296) | (-3.858) | (-1.831) | (-1.938) | (-1.830) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Constant | 18.353* | -6.240* | 21.399* | 16.009 | 30.773** | 16.130* | 12.805 | 14.875* | 12.862 |
| | (1.920) | (-1.832) | (2.030) | (1.632) | (2.797) | (1.744) | (1.475) | (1.712) | (1.478) |
| Observations | 163 | 163 | 163 | 163 | 113 | 162 | 162 | 162 | 162 |
| Adjusted *R*-squared | 0.697 | 0.703 | 0.696 | 0.698 | 0.715 | 0.719 | 0.753 | 0.753 | 0.755 |
| *F*-statistic | 75.695 | 77.660 | 62.949 | 63.314 | 47.837 | 69.966 | 71.765 | 71.146 | 71.419 |

Notes: *t*-statistics in parentheses
** indicates significance at the 1% level
* indicates significance at the 10% level